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BREEDING BIOLOGY OF THE ENDANGERED ROTA BRIDLED WHITE-EYE

FREDERICK A. AMIDON,[1,3,5] CAROLA A. HAAS,[1] AND JOHN M. MORTON[2,4]

ABSTRACT.—Little is known about the breeding biology of Bridled White-eyes (*Zosterops conspicillatus*), especially the federally endangered Rota Bridled White-eye (*Z. c. rotensis*). Here, we report on the breeding behavior, nest-site characteristics, and nest dimensions of Rota Bridled White-eyes. From 1997 to 1999, we found 20 Rota Bridled White-eye nests in *Elaeocarpus joga* (35%), *Hernandia labyrinthica* (30%), *Merrilliodendron megacarpum* (20%), and introduced *Acacia confusa* (15%) trees between 320 and 460 m in elevation. Nests were 2.5–12.8 m above the ground (n = 18) in trees 3.3–14.6 m tall (n = 16). Clutch size ranged from one to two eggs (n = 7) and the breeding season was from at least December through August. Nest dimensions (n = 4) were 36–44 × 57.7–60.8 mm (outer height × diameter) and 25–29 × 44.6–47.7 mm (cup depth × diameter). *Received 1 April 2004, accepted 4 October 2004.*

The Bridled White-eye (*Zosterops conspicillatus*) is a small bird (~10 g) endemic to the Mariana Islands in the tropical western Pacific Ocean. Currently, the species is divided into three subspecies found on the islands of Guam (*Z. c. conspicillatus*); Saipan, Tinian, and Aguiguan (*Z. c. saypani*); and Rota (*Z. c. rotensis*; hereafter referred to as Guam, Saipan, and Rota Bridled White-eyes, respectively; Stresemann 1931). Recent genetic work (Slikas et al. 2000) and observed differences in plumage, vocalizations, and behavior (Pratt et al. 1987, Collar et al. 1994), suggest that the Rota Bridled White-eye may warrant species status.

The Saipan Bridled White-eye is abundant and widespread on the islands of Saipan (2,221 birds per km^2), Tinian (2,931 birds per km^2), and Aguiguan (1,930 birds per km^2; Engbring et al. 1986). Historically, the Guam Bridled White-eye also was believed to be abundant and widespread (Jenkins 1983), although no island-wide surveys were ever completed. After the introduction of the brown treesnake (*Boiga irregularis*), however, the Guam Bridled White-eye population rapidly declined and the subspecies is presumed extinct (Wiles et al. 2003).

The first published record that detailed locations of the Rota Bridled White-eye was of four birds collected by Navy personnel at two low-elevation (0–150 m) areas (Songsong Village and Malilok Point) in 1945 (Baker 1948). Baker (1948) considered the Rota Bridled White-eye "numerous," though no surveys were conducted and bird collection was primarily limited to low-elevation areas. By 1975, the Rota Bridled White-eye population was limited to high-elevation areas in the Sabana region, a plateau 450 m in elevation dominating the topography of the western half of Rota (Pratt et al. 1979). In 1982, the first island-wide, avifaunal survey was completed and the Rota Bridled White-eye population was estimated to be approximately 10,000 birds (183 birds per km^2); it was primarily restricted to high-elevation areas of the Sabana region (Engbring et al. 1986). By 1996, the population was estimated to be approximately 1,000 birds and was further restricted to cliff-line forest in the Sabana region (Fancy and Snetsinger 2001). The cause of this decline is uncertain; however, predation by the introduced Black Drongo (*Dicrurus macrocercus*) and habitat changes appear to be important factors (Craig and Taisacan 1994, Craig 1999, Amidon 2000, Fancy and Snetsinger 2001). Currently, the Rota Bridled White-eye is listed as endangered under the Endangered Species Act (U.S. Fish and Wildlife Service 2004) and

[1] Dept. of Fisheries and Wildlife Sciences (0321), Virginia Polytechnic Inst. and State Univ., Blacksburg, VA 24061, USA.

[2] U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, P.O. Box 8134, MOU-3, Dededo, GU 96912, USA.

[3] Current address: U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, 300 Ala Moana Blvd., Box 50088, Honolulu, HI 96850, USA.

[4] Current address: U.S. Fish and Wildlife Service, Kenai National Wildlife Refuge, P.O. Box 2139, Soldotna, AK 99669, USA.

[5] Corresponding author; e-mail: fred_amidon@fws.gov

critically endangered by the World Conservation Union (2003).

The paucity of life history information about the Rota Bridled White-eye makes it difficult to determine the specific cause of decline. Data on breeding biology are especially limited, as only brief descriptions of three nests have been reported (Yamashina 1932, Pratt 1985, Lusk and Taisacan 1997). Data on incubation, nestling, and fledgling periods, as well as on parental care do not exist. Further, information on the breeding biology of Bridled White-eyes on Saipan and Guam also is very limited. In this paper we report, often for the first time, information on nest-site characteristics, nest dimensions, and breeding behavior of Rota Bridled White-eyes.

METHODS

Observations of all nests were made on the island of Rota (14° 10′ N, 145° 12′ E), Commonwealth of the Northern Mariana Islands (CNMI). Rota is approximately 86 km^2 and has a maximum elevation of 490 m. The island is composed of a series of upraised, coral limestone plateaus formed on an extinct volcanic peak. We conducted our field work primarily within the current range of the Rota Bridled White-eye, from 300 to 450 m in elevation in the Uyulan Hulo, Applatagua, Finata, and Alesna regions from June to August 1998 and from January to August 1999. The climate in the CNMI is tropical, with mean temperatures of 24 to 32° C, high humidity, and average rainfall of 200 to 260 cm (National Oceanic and Atmospheric Administration 1998).

We found nests by actively searching areas used by Rota Bridled White-eyes and by monitoring the movements of individuals carrying nesting material or food items. We monitored all active nests at least every 4 days, using either a mirror on a telescoping pole or a spotting scope. When possible, we recorded clutch size, number of hatchlings and fledged young, and assessed reasons for nest or clutch failure. Because Rota Bridled White-eyes are sexually monomorphic in plumage and none of the adults at active nests was color-banded, sexes could not be identified; however, we recorded observations of switching and simultaneous feeding by both adults to determine the involvement of both sexes in incubation, brooding, and feeding of nestlings and fledglings. When nests were accessible, we attempted to band nestlings with U.S. Geological Survey aluminum bands and distinct combinations of color bands.

At all nests we measured diameter at breast height (dbh) of the nest tree, height of the nest in the tree, nest tree height, tree species (based on the taxonomic classification of Raulerson and Rhinehart 1991), distance from nest to bole, and elevation. When nests were accessible, we also recorded nest dimensions and nest material used. For nest dimensions, we recorded cup diameter and depth, and outside nest diameter and height. Means are presented ± SE.

RESULTS

We found 19 Rota Bridled White-eye nests during the 1998 (June to August) and 1999 (January to August) field seasons. An additional nest was found in December 1997 during preliminary field work (S. M. Plentovich pers. comm.). Ten of the nests were active, and of these, seven produced one or two fledglings. Of the three active nests that failed, one appeared to be depredated at the nestling stage, the 1997 nest was destroyed during Typhoon Paka in December 1997, and the third was depredated or abandoned, possibly due to observer disturbance. Ten nests were considered inactive but were distinguishable from other passerine nests, including those of the Micronesian Honeyeater (*Myzomela rubratra*), based on nest structure, composition, and placement within the nest tree and our observations of Rota Bridled White-eye activity at the nest site.

We found active nests in December (n = 1), March (n = 4), May (n = 2), July (n = 2), and August (n = 1). Fledging dates of two nests indicate that breeding also occurs in April and June. In addition, we observed what appeared to be two recently fledged Rota Bridled White-eyes (no eye-rings and a scruffy appearance) in late January.

Rota Bridled White-eye eggs were light blue and unmarked; clutch size for seven nests ranged from one to two eggs, and we documented the fledging of two nestlings from one nest. Based on our observations at seven active nests, incubation and nestling periods appeared to be at least 10 and as long as 12 days.

During the incubation and nestling stages, we observed both adults incubating eggs and brooding nestlings, and both simultaneously provisioning nestlings. We banded one nestling and documented a post-fledging parental care period of at least 8 days. The banded nestling was seen approximately 10 m from the nest with both adults and another young bird, possibly its nest mate, which had fledged prior to banding. Both birds were observed actively begging (calling and quivering their wings) from both adults and did not appear to be foraging, although they flew and hopped among the branches of trees. We also observed adult Rota Bridled White-eyes constructing and cleaning (eating fecal sacs) nests, but did not observe both adults simultaneously building nests or taking part in nest sanitation.

We found Rota Bridled White-eye nests at 320–460 m in elevation in the native tree species *Elaeocarpus joga* (n = 7), *Hernandia labyrinthica* (n = 6), and *Merrilliodendron megacarpum* (n = 4), and in the introduced *Acacia confusa* (n = 3). Mean height of nests above ground (n = 18) was 8.3 m ± 0.7 (range: 2.5–12.8 m). Mean height of nest trees (n = 16) was 10.3 m ± 0.8 (range: 3.3–14.6 m), and mean dbh of nest trees (n = 17) was 29.9 cm ± 40.2 (range: 2.3–60.2 cm). Mean distance from tree bole to nest (n = 17) was 3.1 m ± 0.4 (range: 0.9–6.7 m).

All Rota Bridled White-eye nests were cup-like and the nests found in *E. joga*, *M. megacarpum*, and *A. confusa* trees were all suspended between branches and branchlets. Five of the six nests found in *H. labyrinthica* were suspended between branches and leaf petioles. The remaining nest was suspended from *Davallia solida* ferns below a *H. labyrinthica* branch.

We measured nest dimensions of four Rota Bridled White-eye nests. Mean outer height was 40.0 mm ± 1.0 (range: 36.0–44.0 mm) and cup depth was 28.0 mm ± 1.0 (range: 25.0–29.0 mm). Mean cup diameter was 45.9 mm ± 0.7 (range: 44.6–47.7 mm) and outer nest diameter was 59.0 mm ± 0.7 (range: 57.7–60.8 mm). All nests appeared to be composed of rootlets, woven grass or *Pandanus* spp. fibers, spider webs, light green moss, and a yellow, cottony material. The inner cup appeared to be composed of woven grass or *Pandanus* spp. fibers. We also observed a Rota Bridled White-eye recycling old nest material to build a new nest; we did not observe white-eyes reusing nests.

DISCUSSION

Previously described nest-site characteristics and nest dimensions (Yamashina 1932, Pratt 1985, Lusk and Taisacan 1997) are similar to what we found. Of the three nests previously reported, only two indicated the tree species in which the nests were found. One nest was in *H. labyrinthica* (Lusk and Taisacan 1997) and the other was in *Hernandia* spp. (presumably *H. labyrinthica*; Pratt 1985). Both nests were also found in areas dominated by *H. labyrinthica/E. joga* mixed forest at >240 m in elevation. In our study we observed the use of three additional tree species, including one introduced species, *A. confusa*; we found 35% of our nests in two additional forest types (*M. megacarpum* and *A. confusa* forests). Lusk and Taisacan (1997) report that the Rota Bridled White-eye breeding season extends from at least March until June. Our observations indicate a breeding season from at least December through August. However, the species probably breeds year-round, as was reported for the Guam Bridled White-eye (Marshall 1949, Jenkins 1983), because nesting was observed in both the wet and dry seasons.

There is little published information on the nests of Saipan and Guam Bridled White-eyes. Yamashina (1932) reported clutch size (1–3 eggs), nest dimensions (40–55 mm outer nest height, 25–30 mm cup depth, 55–65 mm outer diameter, and 40–45 mm cup diameter), nest heights (2–4 m), and nest tree species (*Pithecellobium* spp.) for three Saipan Bridled White-eye nests found on Tinian. Seale (1901) reported nest dimensions (48 mm outer height, 41 mm outer diameter, and 25 mm cup depth) and nest tree species (*Pithecellobium dulce*) for one Guam Bridled White-eye nest. Jenkins (1983) reported on clutch size (2 eggs), nest dimensions (40–50 mm nest diameter and 70–80 mm "deep"), nest height (2.4 m), and nest tree species (*Leucaena leucocephala*) for one Guam Bridled White-eye nest. Hartert (1898) reported on clutch size (2–3 eggs), nest width (50–80 mm), and nest height (1–2 m) for "several" Guam Bridled White-eye nests.

Three active Saipan Bridled White-eye nests were reported at 2.3–6 m above ground in *Casuarina equisetifolia* and *Phragmites karka* (N. C. Johnson unpubl. data).

Overall, the clutch size and nest dimensions we found for the Rota Bridled White-eye are within the range of those reported for both the Saipan and Guam Bridled White-eye. Height above ground of Guam and Saipan Bridled White-eye nests is generally lower (≤6 m) than what we found for the Rota Bridled White-eye. Differences may be due to the limited sample of Guam and Saipan Bridled White-eye nests. Interestingly, all of the identifiable plant species used as nest substrate by Guam and Saipan Bridled White-eyes were introduced to the Mariana Islands, whereas no Rota Bridled White-eye nests were found in any of these plant species. This apparent difference in use of nest substrate is also likely due to the limited sample of Guam and Saipan Bridled White-eye nests.

No information on incubation or nestling and post-fledging parental care periods is available for Bridled White-eyes on Saipan, Tinian, or Guam. Incubation and nestling period data are known for Pale White-eye (*Zosterops pallidus*), Silvereye (*Z. lateralis*), and Japanese White-eye (*Z. japonicus*). The Pale (Broekhuysen and Winterbottom 1968) and Japanese White-eyes (Isobe 1997) have 10–12 day incubation and 10–12 day nestling periods, but the Silvereye has incubation and nestling periods of 12–14 days each (Kikkawa and Wilson 1983). The estimated duration of post-fledging parental care is approximately 2 weeks for the Silvereye (Kikkawa and Wilson 1983) and 15–20 days for the Japanese White-eye (van Riper 2000). Based on this information, the Rota Bridled White-eye's period of post-fledging parental care may be substantially longer than the 8 days we observed; more observations are needed.

Kikkawa and Wilson (1983), report that the eye-ring on recently fledged Silvereye chicks develops after a 1-week period. Van Riper (2000) reports an eye-ring development period of 23 days for the Japanese White-eye. Our observations of one banded fledgling indicated that the eye-ring had not completely developed 8 days after fledging.

Our observations of nest and fledgling attendance reveal that both sexes participate in incubation, brooding, and feeding of nestlings and fledglings. This parallels the behavior of many other white-eye species (Broekhuysen and Winterbottom 1968, Ali and Ripley 1974, Kikkawa and Wilson 1983, van Riper 2000). In most species of white-eyes studied to date, both sexes also participate in nest construction (but see Ali and Ripley 1974). Overall, the breeding behavior of the Rota Bridled White-eye appears similar to that of other white-eye species.

We found Rota Bridled White-eye nests in *H. labyrinthica/E. joga* mixed forest, *M. megacarpum* forest, and introduced *A. confusa* forest only at high elevations (>200 m). Each forest type comprised primarily tall trees (10 m) that were large in diameter (>10 cm; Amidon 2000), and all forests were considered wet forests (Fosberg 1960, Falanruw et al. 1989). Although apparently suitable low-elevation white-eye habitat exists on Rota, white-eyes are now restricted to mature forests at higher elevations for reasons that are unclear.

We recommend additional research on the breeding ecology of Rota Bridled White-eyes and comparisons of their breeding ecology with that of the Saipan Bridled White-eye. The information we obtained in our study was limited; additional research may provide more insight into why the Rota Bridled White-eye is declining—and restricted to high-elevation habitats—and provide valuable information to help manage and recover this critically endangered species.

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